WHAT IS CLAIMED IS:

1. A microcontroller-based system for detecting ground-fault and grounded-neutral conditions in an electrical power distribution system having line and neutral conductors, comprising

- a sensor producing an output signal responsive to current flow in both the line and neutral conductors of the electrical power distribution system,
- a circuit interrupter for interrupting current flow in said power distribution system in response to a trip signal,
- a microcontroller receiving said sensor output signal and initiating the generation of a trip signal upon detection of a ground-fault or a grounded-neutral condition in said power distribution system, said microcontroller being programmed to
- use said sensor output signal to detect ground-fault conditions during spaced time intervals, and
- use said sensor output signal to detect grounded-neutral conditions during intervening time intervals between said spaced interval.

2. The system of claim 1 wherein said microcontroller is programmed to detect ground-fault conditions by comparing the magnitude of said sensor output signal with a predetermined ground-fault threshold value.

3. The system of claim 1 wherein said microcontroller is programmed to detect grounded-neutral conditions by using said sensor output signal to estimate the impedance of the neutral-to-ground connection in said power distribution system.

4. The system of claim 3 wherein said sensor includes a resonant circuit, and said microcontroller is programmed to initiate a ping signal in each of said intervening intervals to produce a damped oscillation in said sensor output signal.

5. The system of claim 4 wherein said microcontroller is programmed to estimate the slope of the leading or tail edge of the half cycles of said damped oscillation by measuring two or more points, within a preselected time interval following the initiation of said ping signal, to determine said grounded-neutral condition.

6. The system of claim 4 wherein said microcontroller is programmed to calculate the slope of M half cycles of said damped oscillation within a preselected time interval following the initiation of said ping signal, and to use said slope to determine said grounded-neutral condition.

7. The system of claim 4 wherein said microcontroller is programmed to compare the peak amplitude of a M half cycles of said damped oscillation with a preselected grounded-neutral threshold value, for each cycle of said damped oscillation within a preselected time interval following the initiation of said ping signal to determine said grounded-neutral condition.

8. The system of claim 4 wherein said microcontroller is programmed to monitor a plurality of half cycles and use the number of half cycles above a preselected threshold, within a preselected time interval following the initiation of said ping signal, to determine said grounded-neutral condition.

9. The system of claim 4 wherein said microcontroller is programmed to determine a grounded neutral condition based on a decay factor of a damped oscillation, within a preselected time interval following the initiation of said ping signal, in the presence of a grounded neutral condition.

10. The system of claim 9 and further where said decay factor is determined by observing a tangential function of an envelope of the peak amplitudes of said damped oscillation.

11. The system of claim 9 and further where said decay factor is determined by calculating a second order estimate of an envelope of the peak amplitues of said damped oscillation.

12. The system of claim 9 and further where said decay factor is determined by calculating a slope of a linear fit of the peak amplitudes of said damped oscillation.

13. The system of claim 9 and further where said decay factor is determined by calculating an estimate of the area below the signal waveform peaks of said damped oscillation.

14. The system of claim 1 wherein said sensor has a single transformer for sensing current in both said line and neutral conductors.

15. A microcontroller-based system for detecting ground-fault and grounded-neutral conditions in an electrical power distribution system having line and neutral conductors, comprising

- a sensor, containing a single current transformer producing an output signal responsive to current flow in both the line and neutral conductors of the electrical power distribution system,
- a microcontroller receiving said sensor output signal and initiating the generation of a trip signal upon detection of said ground-fault or said grounded-neutral condition in said power distribution system, said microcontroller being programmed to
    - use said sensor output signal to detect ground-fault conditions during spaced time intervals, and
    - use said sensor output signal to detect grounded-neutral conditions during intervening time intervals between said spaced time intervals, and
    - a circuit interrupter for interrupting current flow in said power distribution system in response to said trip signal.

16. A method of detecting ground-fault and grounded-neutral conditions in an electrical power distribution system having both line and neutral conductors, comprising

- producing a signal responsive to current flow in both the line and neutral conductors of the electrical power distribution system,
- supplying said signal to a microcontroller that is programmed to
- use said signal to detect ground-fault conditions during spaced time intervals,

- use said signal to detect grounded-neutral conditions during intervening time intervals between said spaced intervals,
- initiate the generation of a trip signal upon detection of a ground-fault or a grounded-neutral condition, and
- interrupting current flow in said power distribution system in response to said trip signal.

17. The method of claim 16 wherein ground-fault conditions are detected by comparing the magnitude of said signal with a predetermined threshold value.

18. The method of claim 16 wherein grounded-neutral conditions are detected by using said signal to estimate the resistance of the neutral-to-ground connection in said power distribution system.

19. The method of claim 18 wherein said signal is produced by a resonant circuit, and said microcontroller initiates a ping signal in each of said intervening time intervals to produce a damped oscillation in said signal, and compares said damped oscillation with a reference value to determine whether a grounded-neutral condition has occurred.

20. The method of claim 19 wherein said microcontroller compares the peak amplitude of said damped oscillation with a preselected grounded-neutral threshold value, for each cycle of said damped oscillation within a preselected time interval following the initiation of said ping signal.

21. The system of claim 16 wherein current in both said line and neutral conductors is sensed with a single transformer.

22. A method of detecting ground-fault and grounded-neutral conditions in an electrical power distribution system having both line and neutral conductors and a sensor circuit producing a signal responsive to current flow in both the line and neutral conductors of the electrical power distribution system, comprising

- using a real-time clock to produce spaced time intervals,
- sampling said signal at said spaced time intervals,

- using the signal sample from each spaced time interval to detect a ground-fault condition, and setting a ground-fault indicator in response to the detection of a ground-fault condition,
- using said signal sample to detect a neutral-to-ground fault condition, and setting a neutral-to-ground fault indicator in response to the detection of a neutral-to-ground fault condition,
- initiating the generation of a trip signal in response to the setting of a ground-fault or a neutral-to-ground indicator, and
- interrupting current flow in said power distribution system in response to said trip signal.

23. The method of claim 22 wherein said signal sample is used to detect a ground-fault condition by monitoring the lowest voltage of a negative voltage cycle, and setting said ground-fault indicator if said lowest voltage falls below a predetermined high threshold value.

24. The method of claim 22 wherein said signal sample is used to verify a ground-fault condition by monitoring the lowest voltage of a negative voltage cycle, and resetting the ground-fault indicator if said lowest voltage is higher than a predetermined low threshold value.

25. The method of claim 22 wherein said signal sample is used to initiate a ping signal to induce a resonant voltage oscillation in said sensor circuit if said signal sample is of zero or greater voltage.

26. The method of claim 25 wherein said signal sample is used to determine the presence of a neutral-to-ground condition by monitoring the rate of decay of said induced resonant oscillation in said sensor circuit, and setting said neutral-to-ground fault indicator if said rate of decay is in excess of a predetermined neutral-to-ground threshold value.